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1 [Improving the surface cycle structure for hexahedral mesh generation](#)

Matthias Müller-Hannemann

May 2000 **Proceedings of the sixteenth annual symposium on Computational geometry**
 Full text available: [pdf\(1.27 MB\)](#) Additional Information: [full citation](#), [references](#), [index terms](#)


2 [Efficient adaptive meshing of parametric models](#)

Alla Sheffer, Alper Üngör

May 2001 **Proceedings of the sixth ACM symposium on Solid modeling and applications**
 Full text available: [pdf\(1.45 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


Parametric modeling is becoming the representation of choice for most modern solid modelers. However, when generating the finite-element mesh of the model for simulation and analysis, most meshing tools ignore the parametric information and use only the boundary representation of the model for meshing. This results in re-meshing the model basically from scratch each time a parametric change is instantiated, which happens numerous times throughout the design process.

In this paper we l ...

Keywords: adaptivity, mesh generation, parametric models

3 [Skeleton-based modeling operations on solids](#)

Duane W. Storti, George M. Turkiyyah, Mark A. Ganter, Chek T. Lim, Derek M. Stal

May 1997 **Proceedings of the fourth ACM symposium on Solid modeling and applications**
 Full text available: [pdf\(2.02 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)


4 [Layered tetrahedral meshing of thin-walled solids for plastic injection molding FEM](#)

Soji Yamakawa, Charles Shaw, Kenji Shimada

June 2005 **Proceedings of the 2005 ACM symposium on Solid and physical modeling**

Full text available:  pdf(1.04 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper describes a method for creating a well-shaped, layered tetrahedral mesh of a thin-walled solid by adapting the surface triangle sizes to the estimated wall thickness. The primary target application of the method is the finite element analysis of plastic injection molding, in which a layered mesh improves the accuracy of the solution. The edge lengths of the surface triangles must be proportional to the thickness of the domain to create well-shaped tetrahedrons; when the edge lengths a ...

Keywords: finite element method, plastic injection molding, tetrahedral mesh

5 Combinatorics helps for hexahedral mesh generation in CAD 

Matthias Müller-Hannemann

January 1999 **Proceedings of the tenth annual ACM-SIAM symposium on Discrete algorithms**

Full text available:  pdf(260.91 KB) Additional Information: [full citation](#), [references](#), [index terms](#)

6 CHARMS: a simple framework for adaptive simulation 

Eitan Grinspun, Petr Krysl, Peter Schröder

July 2002 **ACM Transactions on Graphics (TOG) , Proceedings of the 29th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 3

Full text available:  pdf(3.56 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Finite element solvers are a basic component of simulation applications; they are common in computer graphics, engineering, and medical simulations. Although *adaptive* solvers can be of great value in reducing the often high computational cost of simulations they are not employed broadly. Indeed, building adaptive solvers can be a daunting task especially for 3D finite elements. In this paper we are introducing a new approach to produce *conforming*, *hierarchical*, *adaptive refinement* meth ...

Keywords: adaptive computation, basis function, multiresolution, refinement relation, subdivision

7 Texture mapping 3D models of real-world scenes 

Frederick M. Weinhaus, Venkat Devarajan

December 1997 **ACM Computing Surveys (CSUR)**, Volume 29 Issue 4

Full text available:  pdf(1.98 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#), [review](#)

Texture mapping has become a popular tool in the computer graphics industry in the last few years because it is an easy way to achieve a high degree of realism in computer-generated imagery with very little effort. Over the last decade, texture-mapping techniques have advanced to the point where it is possible to generate real-time perspective simulations of real-world areas by texture mapping every object surface with texture from photographic images of these real-world areas. The techniqu ...

Keywords: anti-aliasing, height field, homogeneous coordinates, image perspective transformation, image warping, multiresolution data, perspective projection, polygons, ray tracing, real-time scene generation, rectification, registration, texture mapping, visual simulators, voxels

8 Volume rendering II: View-dependent multiresolution splatting of non-uniform data

Justin Jang, William Ribarsky, Christopher D. Shaw, Nickolas Faust

May 2002 **Proceedings of the symposium on Data Visualisation 2002 VISSYM '02**Full text available:  [pdf\(663.32 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper develops an approach for the splat-based visualization of large scale, non-uniform data. A hierarchical structure is generated that permits detailed treatment at the leaf nodes of the non-uniform distribution. A set of levels of detail (LODs) are generated based on the levels of the hierarchy. These yield two metrics, one in terms of the spatial extent of the bounding box containing the splat and one in terms of the variation of the scalar field over this box. The former yields a view ...

9 Parallel Cell Projection Rendering of Adaptive Mesh Refinement Data

Gunther H. Weber, Martin Ohler, Oliver Kreylos, John M. Shalf, E. Wes Bethel, Bernd Hamann, Gerik Scheuermann

October 2003 **Proceedings of the 2003 IEEE Symposium on Parallel and Large-Data Visualization and Graphics PVG '03**Full text available:  [pdf\(284.91 KB\)](#)Additional Information: [full citation](#), [abstract](#)

Adaptive Mesh Refinement (AMR) is a technique used in numerical simulations to automatically refine (or de-refine) certain regions of the physical domain in a finite difference calculation. AMR data consists of nested hierarchies of data grids. As AMR visualization is still a relatively unexplored topic, our work is motivated by the need to perform efficient visualization of large AMR data sets. We present a software algorithm for parallel direct volume rendering of AMR data using a cell-project ...

Keywords: volume rendering, adaptive mesh refinement, load balancing, multi-grid methods, parallel rendering, visualization

10 Volume probes: interactive data exploration on arbitrary grids

Don Speray, Steve Kennon

November 1990 **ACM SIGGRAPH Computer Graphics , Proceedings of the 1990 workshop on Volume visualization**, Volume 24 Issue 5Full text available:  [pdf\(736.63 KB\)](#)Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

A taxonomy of computational grids used in scientific and engineering practice is presented and a technique for cutting them by, and displaying data on, 2D surfaces is developed. When sliced by a surface, these grids give rise to a graph $G(C, F)$ where C , the nodes, are the intersected cells and F , the arcs, are their connectivity across faces. Starting from any cell known to be intersected by the surface (a seed), G is traversed breadth-first and is constructed locally on the fly, that is, only t ...

11 CartaBlanca— a pure-Java, component-based systems simulation tool for coupled non-linear physics on unstructured grids

W. B. VanderHeyden, E. D. Dendy, N. T. Padial-Collins

June 2001 **Proceedings of the 2001 joint ACM-ISCOPE conference on Java Grande**Full text available:  [pdf\(924.14 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper describes a component-based non-linear physical system simulation prototyping package written entirely in Java using object-oriented design to provide scientists and engineers a “developer-friendly” software environment for large-scale computational method and physical model development. The software design centers on the Jacobian-Free Newton-Krylov solution method surrounding a finite-volume treatment of conservation equations. This enables a clean component-based impl ...

Keywords: Jacobian, Java object oriented, Krylov, Newton, components, parallel, physics, solver, threads

12 Free-form shape design using triangulated surfaces

William Welch, Andrew Witkin

July 1994 **Proceedings of the 21st annual conference on Computer graphics and interactive techniques**

Full text available: [pdf\(1.41 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We present an approach to modeling with truly mutable yet completely controllable free-form surfaces of arbitrary topology. Surfaces may be pinned down at points and along curves, cut up and smoothly welded back together, and faired and reshaped in the large. This style of control is formulated as a constrained shape optimization, with minimization of squared principal curvatures yielding graceful shapes that are free of the parameterization worries accompanying many patch-based approaches. ...

Keywords: Delaunay triangulation, adaptive meshing, fair surface design, functional minimization, polygonal models

13 A Computational Database System for Generating Unstructured Hexahedral Meshes with Billions of Elements

Tiankai Tu, David R. O'Hallaron

November 2004 **Proceedings of the 2004 ACM/IEEE conference on Supercomputing**

Full text available: [pdf\(222.13 KB\)](#) Additional Information: [full citation](#), [abstract](#)

For a large class of physical simulations with relatively simple geometries, unstructured octree-based hexahedral meshes provide a good compromise between adaptivity and simplicity. However, generating unstructured hexahedral meshes with over 1 billion elements remains a challenging task. We propose a database approach to solve this problem. Instead of merely storing generated meshes into conventional databases, we have developed a new kind of software system called Computational Database System ...

14 Three-dimensional object recognition

Paul J. Besl, Ramesh C. Jain

March 1985 **ACM Computing Surveys (CSUR)**, Volume 17 Issue 1

Full text available: [pdf\(7.76 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

A general-purpose computer vision system must be capable of recognizing three-dimensional (3-D) objects. This paper proposes a precise definition of the 3-D object recognition problem, discusses basic concepts associated with this problem, and reviews the relevant literature. Because range images (or depth maps) are often used as sensor input instead of intensity images, techniques for obtaining, processing, and characterizing range data are also surveyed.

15 Subdivision surfaces in character animation

Tony DeRose, Michael Kass, Tien Truong

July 1998 **Proceedings of the 25th annual conference on Computer graphics and interactive techniques**

Full text available: [pdf\(32.74 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

16 Homotopy-preserving medial axis simplification

Avneesh Sud, Mark Foskey, Dinesh Manocha

June 2005 **Proceedings of the 2005 ACM symposium on Solid and physical modeling**Full text available:  [pdf\(491.41 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

We present a novel algorithm to compute a simplified medial axis of a polyhedron. Our simplification algorithm tends to remove unstable features of Blum's medial axis. Moreover, our algorithm preserves the topological structure of the original medial axis and ensures that the simplified medial axis has the same homotopy type as Blum's medial axis. We use the separation angle formed by connecting a point on the medial axis to closest points on the boundary as a measure of the stability of the med ...

Keywords: homotopy, medial axis, separation angle, simplification, voronoi diagram

17 Poster session: Adaptive and quality 3D meshing from imaging data

Yongjie Zhang, Chandrajit Bajaj, Bong-Soo Sohn

June 2003 **Proceedings of the eighth ACM symposium on Solid modeling and applications**Full text available:  [pdf\(558.09 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper presents an algorithm to extract adaptive and quality 3D meshes directly from volumetric imaging data - primarily Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). The extracted tetrahedral and hexahedral meshes are extensively used in finite element simulations. Our comprehensive approach combines bilateral and anisotropic (feature specific) diffusion filtering, with contour spectrum based, isosurface and interval volume selection. Next, a top-down octree subdivision cou ...

Keywords: 3D meshes, adaptive, feature sensitive, hanging nodes, quality

18 A unified approach for hierarchical adaptive tessellation of surfaces

Luiz Velho, Luiz Henrique de Figueiredo, Jonas Gomes

October 1999 **ACM Transactions on Graphics (TOG)**, Volume 18 Issue 4Full text available:  [pdf\(1.08 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

This paper introduces a unified and general tessellation algorithm for parametric and implicit surfaces. The algorithm produces a hierarchical mesh that is adapted to the surface geometry and has a multiresolution and progressive structure. The representation can be exploited with advantages in several applications.

Keywords: adapted meshes, geometric modeling, implicit surfaces, multiresolution representations, parametric surfaces, polygonization, surface approximation

19 Efficient subdivision of finite-element datasets into consistent tetrahedra

Guy Albertelli, Roger A. Crawfis

October 1997 **Proceedings of the 8th conference on Visualization '97**Full text available:  [pdf\(783.51 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)
 [Publisher Site](#)

Keywords: flow visualization, irregular grids, isosurfaces metrics, mesh subdivision,

tetrahedralization, volume rendering

20 Producing High-Quality Visualizations of Large-Scale Simulations



Voicu Popescu, Chris Hoffmann, Sami Kilic, Mete Sozen, Scott Meador

October 2003 **Proceedings of the 14th IEEE Visualization 2003 (VIS'03) VIS '03**

Full text available: [pdf \(432.52 KB\)](#) Additional Information: [full citation](#), [abstract](#)

This paper describes the work of a team of researchers in computer graphics, geometric computing, and civil engineering to produce a visualization of the September 2001 attack on the Pentagon. The immediate motivation for the project was to understand the behavior of the building under the impact. The longer term motivation was to establish a path for producing high-quality visualizations of large scale simulations. The first challenge was managing the enormous complexity of the scene to fit wit ...

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